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AUTHOR White, June Miller
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ABSTRACT

A developmental mathematics program at Hill Top Preparatory School in Rosemont, Pennsylvania is designed to help learning disabled students prepare for jobs and college work. Intended for non-college bound as well as for the college bound, the program emphasizes aspects of environment (appropriate placement, self pacing, small groups), process (sequential instruction, stress on learning style), and staff (recognition of student's potential and development of trust). Four curriculum components are involved: fundamentals, including basic computations and basic decisionmaking, traditional secondary content, computer science, and college level work. Standardized tests are administered based on functioning level. (CL)

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A DEVELOPMENTAL MATHEMATICS PROGRAM FOR LEARNING DISABLED ADOLESCENTS

BACKGROUND

A developmental mathematics program for learning disabled adolescents has been developed, refined, and shown to be effective over the past thirteen years at Hill Top Preparatory School in Rosemont, PA, a main line suburb of Philadelphia. The goal of this program is to enable learning disabled adolescents to enjoy success while acquiring the cognitive skills necessary for jobs and for college work. The curriculum is designed for both the non-college bound and for the college preparatory student. It is presently working very successfully with both males and females ranging in age from twelve to twenty years of age.

Drawing upon Piagetian and other developmental theories, the foundation of the program is two fold:

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-- Instruction is based on the level at which the student is presently functioning rather than chronological age and
-- Movement of the student through the program is at a pace the student can successfully handle.

ESSENTIALS: Environment

The essential aspects of the program involve environment, process, and staff. The environment encompasses placement, grouping, and pacing. The process emphasizes sequential instruction and knowledge of each student's learning style. The staff needs to recognize the student's potential in mathematics and to develop trust between instructor and learner.

Appropriate Placement Students are placed at the point where the most elementary gap or problem exists. For example, if diagnostic work demonstrates the most elementary gap is regrouping in subtraction of whole numbers, the student is placed so that the knowledge missing in that gap can be acquired. Through analysis of a student's work on standardized tests as well as their

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intellectual potential and academic background, placement can be made in the appropriate course.

The Stanford Achievement Test is used to assess academic achievement, a full psychological report including subtest scores on the Wechsler Intelligence Scale for Children is used to estimate intellectual potential, and transcripts from previous academic years are analyzed to determine previous successes or failures in mathematics. Through further diagnostic procedures within the classroom (teacher observations and specific skill tests) specific weaknesses are pinpointed and then strengthened.

Self-paced Program for Basic Computational Skill Basic computational skills include addition, subtraction, multiplication and division of whole numbers, common fractions and decimal fractions, as well as work with percents and measurement. If students need work in the basics there is continual in-class diagnosis and students move through this basic skills part of the program as quickly as each individual can. The time for this varies from a few months to two years.

Small Groups Adolescents needing work on basic computation receive individual instruction permitting them to progress at their own pace. This requires groups of six or less. Students ready for the traditional secondary courses are in slightly larger groups. Hill Top recommends eight as the maximum in these groups.

ESSENTIALS: Process

Sequential Instruction Instruction begins where the student is presently functioning. It does not assume knowledge the student may not have. Content is developed sequentially building upon a student's mastery of previous content. This assures each student the opportunity to be successful, rather than "setting him/her up" for failure. For many learning disabled students, previous failures in mathematics have often occurred because students lacked prerequisite skills,

not because of any lack of mathematical aptitude or reasoning ability.

Emphasis on Process Instructional techniques take into account each student's learning style. For example, visual learners require that everything be written down. They learn less effectively through a lecture style. Some learners cannot take in information if the instructor is talking and writing at the same time. These learners require instruction that does both, but only one at a time. Instructors utilize each student's learning style and assist each student to develop an awareness of his/her own style. The process becomes as important as the content.

ESSENTIALS: Staff

Recognition of Student's Potential By definition learning disabled students are average or above average in intelligence. Studies indicate learning disabled adolescents can reason as well as their normal learning peers but may have difficulty with specific language usage. Learning disabled students often have reading and language deficits, but mathematics requires word for word reading and specific words usually have only one meaning in mathematics. Math, therefore, is a subject in which learning disabled adolescents can be quite successful if prerequisite content has been mastered and present content is presented sequentially. In addition, mathematics is a secondary subject which will provide the background for any careers.

Development of Trust By the time a learning disabled student reaches adolescence, he/she has experienced much frustration. Some have learned to distrust educators since educators sometimes do not seem to know what to do with them. The Hill Top math program requires teachers who like students and who like mathematics, who understand adolescence and learning disabilities, and who are trained in mathematics.

CURRICULUM COMPONENTS

The curriculum has four components, some of which overlap. The first

component is mastery of fundamentals. The second is acquisition of traditional secondary content. The third is knowledge of computer science, and the fourth is college level work. Students take at least one mathematics course every year; some request a second mathematics course as an elective. Each course meets five times weekly and grades are given on report cards.

Fundamentals Mastery of fundamentals is required before students begin work in other areas. This component includes both basic computations and basic decision making skills. Any student entering the program who tests below a 7.0 grade equivalency on the Stanford Achievement Test, 7th Edition, and who is 12-14 years old is placed in a course called Basic Skills. If students are functioning below 8.0 on the Stanford Achievement Test and are 15-18 years old, they work on fundamental calculations in a course called Basic Review.

Both courses review the four basic operations with whole numbers, common fractions, and decimal fractions. Both also include percents, measurement, and one or two step word problems. The Brueckner Inventory Tests (McGraw-Hill) are used to determine individual strengths and weaknesses in basic computations. Teacher observation contributes additional information regarding each student's style of learning. Outside assignments are not given in Basic Skills. An adolescent needing work in basic computations needs to be supervised and mistakes corrected immediately. A student doing several problems incorrectly at home has reinforced the wrong concept. This actually slows his/her progress.

If multiplication facts have not yet been memorized, students make a chart (or a chart is taped on the top of the desk) and check facts for themselves. This results in visual reinforcement, more independence for the student, and an emphasis on process.

Students are individually instructed in these courses and complete the objectives in as little as a semester or as much as two years. The two courses, Basic Skills and Basic Review, use different texts, but both have the same

primary goal: successful performance of basic calculations.

The other area in this component involves development of basic decision making skills. The student learns to sequence several steps in word problems, to interpret data, and to estimate answers. He/She learns to self-ask and self-answer such questions as:

-- How do I get started?
-- What do I do first?
-- What do I do second?
-- What information is relevant?
-- What information is irrelevant?
-- What additional information is needed?
-- What question is the problem really asking?
-- What do I need to know to find the answer?
-- What would I estimate the answer to be?
-- Did I answer the question?
-- Is my answer in the right form?

In this course called Consumer Mathematics, the students learn appropriate behavior with peers and teachers through group instruction. Development of effective organization of work, strong study skills, and preparation of acceptable outside assignments are emphasized.

Traditional Secondary Content Once students have mastered both the fundamental computations ad the decision making skills they are ready to begin work in the second component, traditional secondary content. A student's functioning level must be above 8.5 to begin work in Pre-Algebra. After this is passed, the program includes Elementary Algebra, Geometry, Intermediate Algebra, and Trigonometry. Each course is a prerequisite for the next and all require a functioning level of 9.0 or higher. A prerequisite is satisfied only with a grade of "C" or higher. All courses are completed in two semesters with the exception of Elementary Algebra which can require two, three, or four semesters. All are taught in groups and all have outside assignments.

Computer Science The third component is computer science. It overlaps the second because students begin work with computers in the Pre-Algebra class,

where they work with computers one day each week. After passing Pre-Algebra students may then select an introductory computer science course using BASIC as an elective. They also may continue with an advanced computer science course in BASIC or in COBOL. Computers are extremely helpful to learning disabled for many reasons.

-- Computers expect mistakes. Errors are acceptable. Students learn to correct their work and to try alternatives.
-- Computers are predictable. The sequence is defined. One step at a time is required.
-- Computers individualize and are patient.
-- Computers require specificity. One word has one meaning to the computer.
-- Computers encourage students to be logical and analytical, to identify and isolate each step in the process.
-- Computers support a metacognitive style of instruction in which students learn how to learn.

College Level Work Some students complete the traditional secondary mathematics and are ready for the fourth component, college level work. These students take courses individually instructed on the campus or travel for group instruction to nearby universities such as Villanova University, which is only one mile away. Students who enroll for a college course off campus have schedules which permit them time each day to confer with a mathematics teacher at Hill Top. Often the transition to college level work requires much assistance in the early weeks and less as the students become more confident in their performance.

STANDARDIZED EVALUATIONS

Progress is formally evaluated by standardized tests. Once each year, each student takes the full battery of the Stanford Achievement Tests. The subtests may come from different levels depending upon the student's performance the previous year. The testing, as the placement, is based on functioning level. If a student scores above the range for a particular level, he/she is tested on

the next level in that subtest. All juniors take the Preliminary Scholastic Aptitude Test (PSAT) and all seniors take the Scolastic Aptitude Test (SAT). Scores are discussed with each student individually. In addition, each student must score at ninth grade level or above on the Stanford Test of Academic Skills (TASK) before graduation. Over seventy percent of Hill Top gradates go to college and many choose math related fields.

The following chart illustrates SAT results over the past five years.

MATHEMATICS SCORES BY CLASSES ON THE SAT

Year Graduated	79	80	81	82	83
Median Score	350	360	330	390	370
National Percentile	41	44	29	53	47
Range of Scores	220-530	310-510	270-450	240-520	210-640

These same classes on the TASK had median scores well over the 60th percentile for twelfth grade norms their senior year. It should be noted that 20-50 percent of these same graduating classes scored fifth grade or below on math computation when admitted to the program. Students are in the program an average of three years.

CONCLUSION

Many learning disabled adolescents are bright, but carry with them a history of failure and dislike for mathematics. These students are discouraged: "I've done this a million times." These students are frustrated: "I don't WANT to do this." A well-trained teacher-therapist will translate this to mean: "I don't understand and I CAN'T do this." A good teacher will distinguish between aptitude and a student's past history in mathematics. A frustrated adolescent cannot make that distinction. He/She only knows: "I had trouble before. I'll have trouble again."

The development of a trust relationship between student and teacher allows the student to make an effort once again. The Hill Top program encourages this trust by being honest with the student. The program says to the student: This is where you are, this is what you already know, and this is what needs to be done. The program is content AND process oriented. Student-centered, it focuses on the needs of each individual student. There are no gimmicks and no watering down but the pace is at the student's level. There is no magic text or simple technique that makes everything work. There IS an approach that views each student as important and math as a sequential subject in which learning disabled students CAN succeed.

All Hill Top math teachers are math-certified except for those who teach only basic courses in which case they are certified in special education only. This recognized the potential each student has for success in mathematics and the powerful tool math will be for success after secondary school.

The Hill Top math program attempts to deal with the true disability and not with the presumed deficiencies. Lewis Carroll, author of Alice in Wonderland wrote:

> "'What's one and one and one and one and one and one and one and one and one and one?'
> 'I don't know,' said Alice, 'I lost count.'
> 'She can't do addition,' said the Red Queen."

The wrong conclusions are also made about our learning disabled. Learning disabled adolescents can do addition as well as traditional secondary mathematics. Educators need to program effectively to enable learning disabled adolescents to acquire the skills missing in their previous work and then acquire the skills required in their future work.

June Miller White, Ph.D., Director of Research and Special Projects, Hill Top Preparatory School, Rosemont, Pennsylvania

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